2016

Session D, 2016 First Place: Mighty Moss: The water-holding capacity, heat retention, and debris content of local moss genera in relation to its use as a traditional diaper material

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Sphagnum Sisters
Jodie Schoelkopf, Megan Ferreira, Emma Livingston,
& Mia Eddy

ESF

Rationale & Importance of the Study

- Vast amounts of indigenous knowledge, but limited amount of literature that connects traditional plant usage with Western scientific methodology (Harris 2008)
- Mosses have been used in different cultures worldwide (Harris 2008 and Glime 2013)
- What moss genus would have been used locally as diaper material? Why?

Photo by Bob Klips

Chosen Moss Genera (Experimental Units)

Carpet Moss (*Dicranum*)

- Insect repellant
- Resistant to mold
- Diaper lining

(Johnson 1995)

Haircap Moss (*Polytrichum*)

- Cloaks

(Beever 1995)

Pincushion Moss (*Leucobryum*)

- Cushion and mattress stuffing

(Glime 2013)

Peat Moss (*Sphagnum*)

- Cradles, Diapers
- Insulation
- Pillow and mattress stuffing

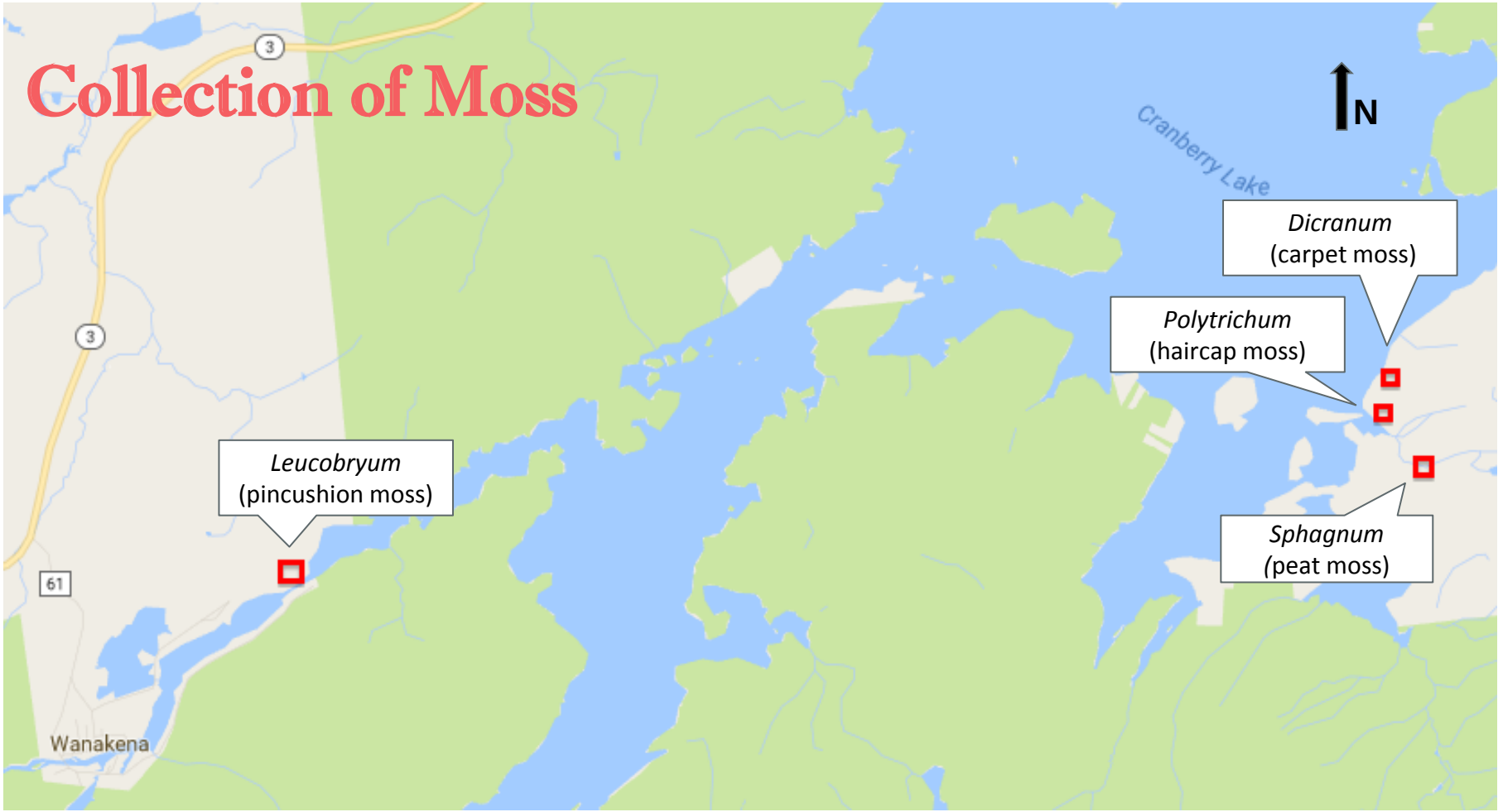
(Harris 2008)

Processed Cotton (*Gossypium*)

- Modern day diapers (Mesek 1981)

Photos by Jodie Schoelkopf

Collection of Moss



Cranberry Lake

|_____| = 5000 ft

Data

- Categorical
- Quantitative

Statistical Tests

- Descriptive statistics
- ANOVA

Sample Units

- Experiment 1: 10g fresh samples of each experimental unit
- Experiment 2: 10g samples of each experimental unit, saturated in water
- Experiment 3: Mesh bags of each experimental unit, density of 1g/mL

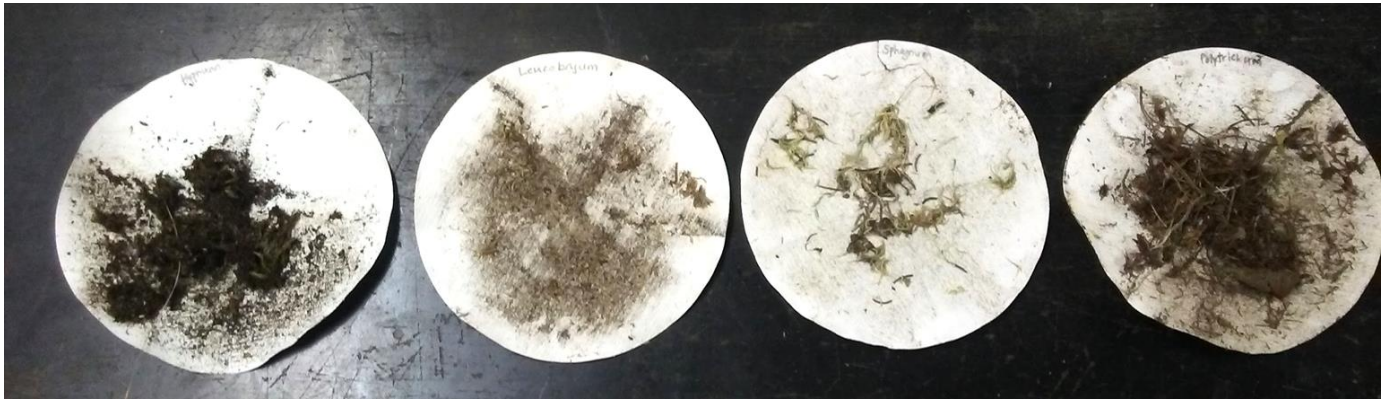
Hypothesis 1: Contained Debris

H_{01}: There will be no difference between the amount of debris (g) filtered from each moss

H_{a1}: *Sphagnum* will contain the least debris (g) relative to other moss genera

Methods:

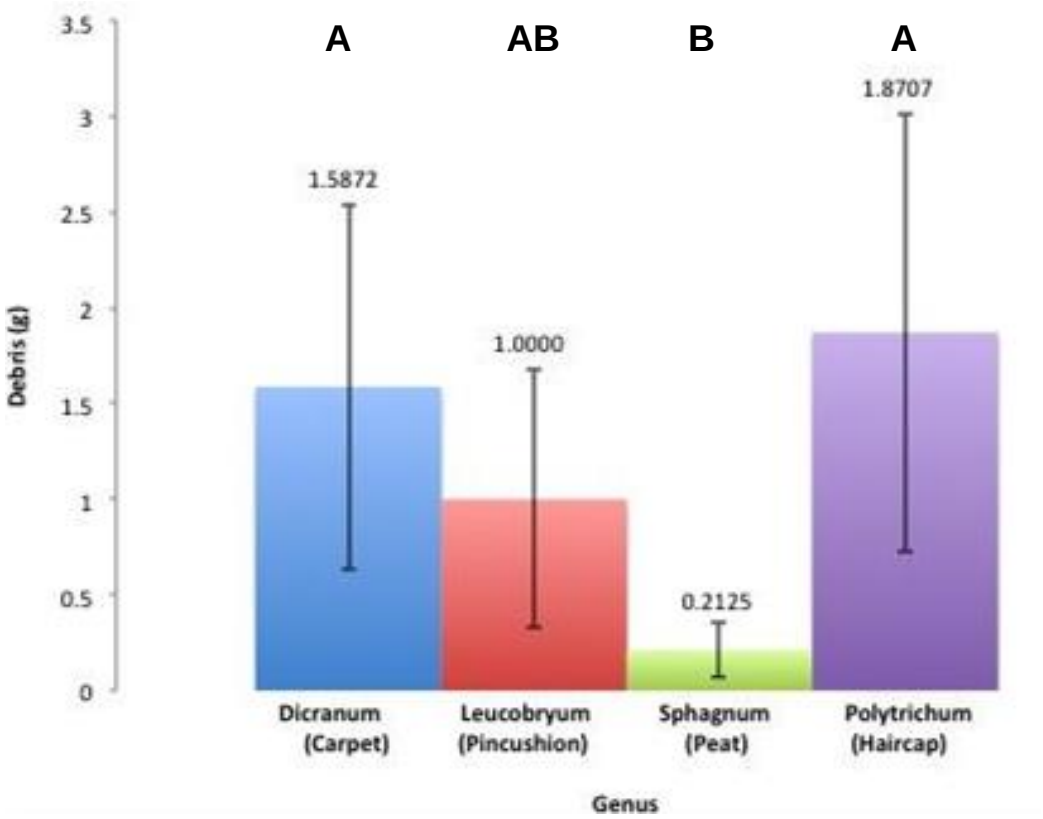
- 10g samples agitated in water and debris allowed to fall to bottom
- Debris was filtered through filter paper
- The debris covered filter paper was dried in a drying oven
- 10 trials



Carpet Pincushion Sphagnum Haircap

Photos by Jodie Schoelkopf (2016)

Results: Contained Debris



F-value = 7.93
P-value = 0.0003
SE = 0.3676
DF = 3

Figure 1. Debris entrapped within 10g of each variable. Variable grouped using Tukey's test.

Hypothesis 2: Water Holding Capacity

H_{02}: There will be no difference between the water holding capacity (mL) of mosses

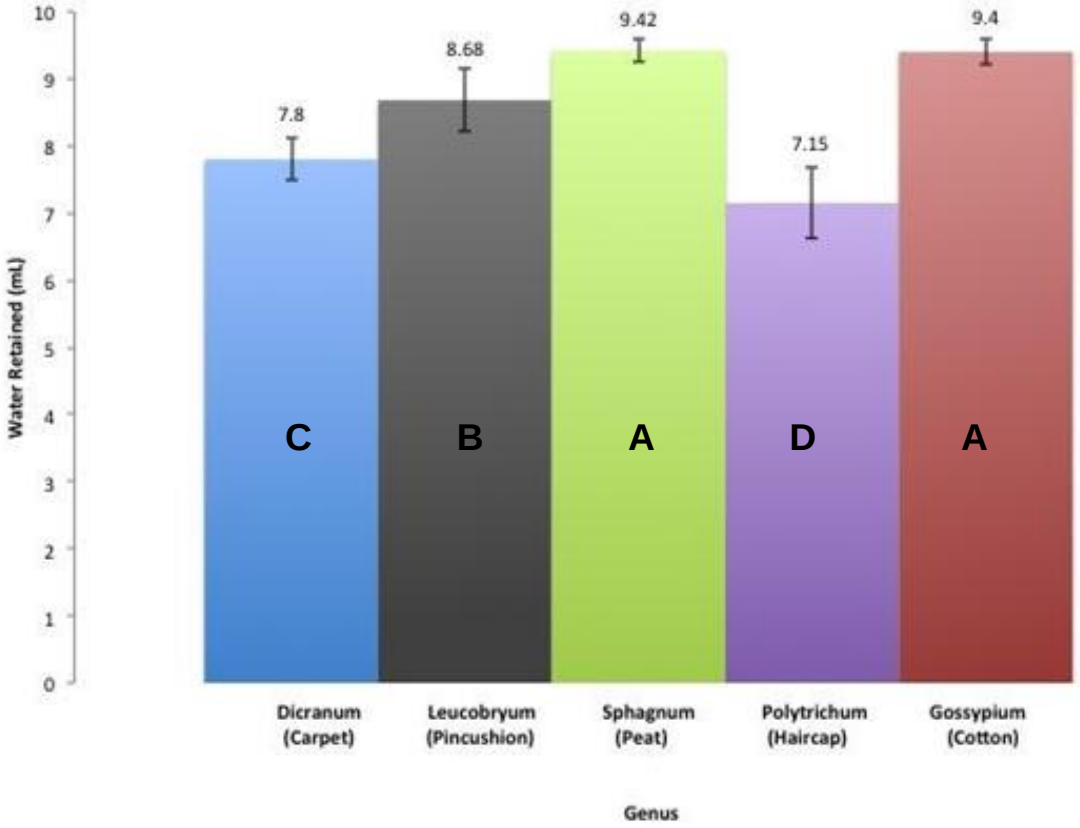
H_{a2}: *Sphagnum* will have the highest water holding capacity (mL) relative to other moss genera

Methods: Water Capacity

- Substrates soaked for ten minutes to allow maximum absorption
- Dehydrated until brittle
- Dry weight (g) subtracted from wet weight to calculate the amount of water (mL) retained in each variable
- 10 trials

Photos by Jodie Schoelkopf 2016

Results: Water Capacity



F = 75.83
P-value = <0.001
SE = 0.1619
DF = 4

Figure 2. Amount of water (mL) in 10g of saturated substrate. Variables grouped using Tukey's test.

Hypothesis 3: Heat Retention

H_{03}: There will be no difference in the rate of heat loss (°C/min) between all variables

H_{a3}: *Sphagnum* will have the slowest rate of heat loss (°C/min) relative to the other variables

Methods:

Each material placed in a mesh bag at a density of 1g/mL

- The mesh bags were heated by being soaked in 37.7 °C water for five minutes
- Removed from heat
- Temperature change tracked every five minutes over a span of 60 minutes.

Photo by Jodie Schoelkopf 2016

Results: Heat Retention

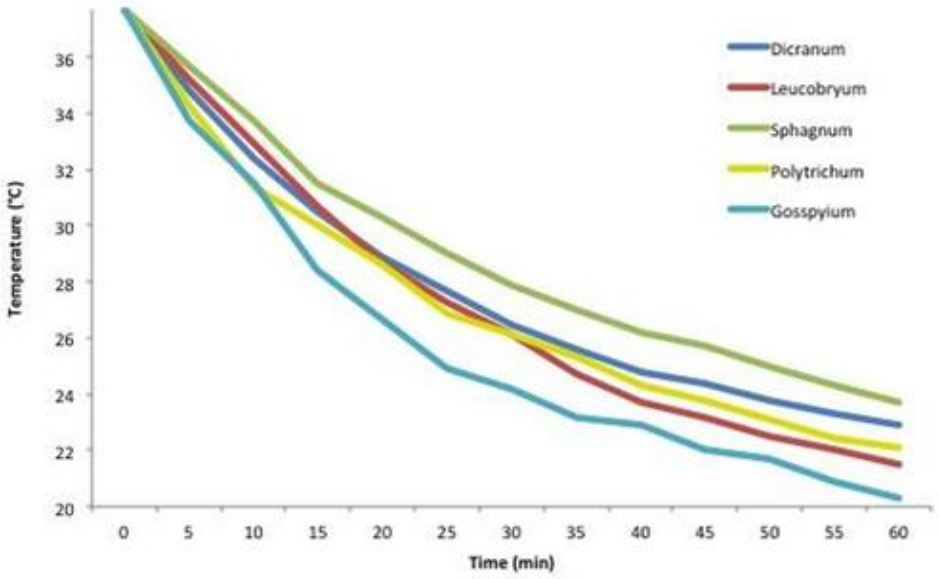


Figure 3. Heat loss over time (°C/min) in each variable over 60 minutes.

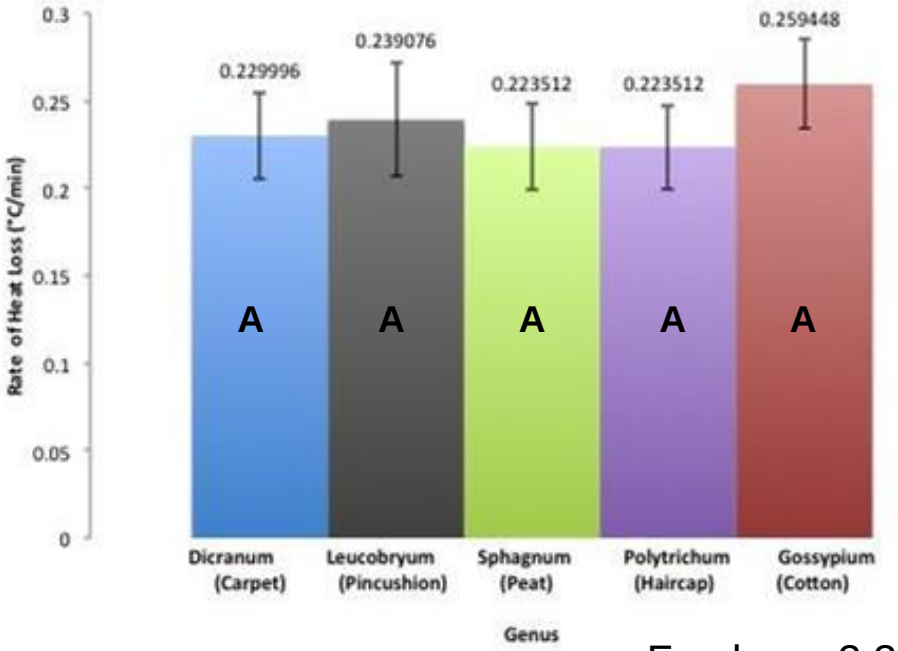


Figure 4. Mean heat loss over time (°C/min) in each variable. Variables grouped with Tukey's test.

F-value = 2.32
P-value = 0.091
SE = 0.01665
DF = 4

Discussion: Reasoning Behind Results

- *Sphagnum* made up of a single layer of cells

  -Photosynthetic cells and dead hyaline cells (Glime 2013)

  -Whorled structure of *sphagnum* and the absorbent hyaline cells allow for high water capacity

  -An osmophillic layer with pores for absorption (Glime 2013)

- *Polytrichum* has both water and sugar conducting cells

  -can obtain nutrients from the soil rather than the environment (Glime 2013).

  -also have waxy cuticle that repels rather than absorbs water (Proctor, 1979).

Discussion: Why does it matter?

- Supports Traditional Ecological Knowledge (TEK)
- Indigenous peoples in the region would have most likely chosen *Sphagnum* for use in diapers
- Comparable to today's cotton diapers

  ... in fact it's better!
  - Biodegradable and unprocessed

Photo by Megan Ferreira 2016

Follow Up Studies

- Abundance of moss genera in different regions to infer which may have been used most by the people of that area
- Antimicrobial properties (Singh et. al., 2007 and Hotson, 1921)
    - Evolutionary relationship between moss usage in nest building and fecal sacs in birds
- Heat retention in samples of non-saturated moss genera
    - Water may have acted as an insulator

Photo by Jay Greenberg

Photo by Megan Ferreira 2016

Conclusion

- *Sphagnum* contained the least amount of debris
- Water retention is greatest in *Sphagnum*, on par with processed cotton
- Heat retention is greatest in *Sphagnum* compared to cotton and other moss genera tested, however is not statistically significant
- *Polytrichum* did not retain water and heat well, and contained the most debris

➢ This data supports the use of *Sphagnum* by traditional cultures in its cleanliness and absorbent properties, and suggests it has the greatest potential as a traditional diaper material.

Acknowledgments

- Dr. Robin W. Kimmerer
- Dr. Kim Shultz
- Dr. Melissa Fierke
- Mr. Giuseppe Tumminello
- Work studs: Joey, Michelle, & Kristen
- The moss

Thank you!

Photo by Bob Klips

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THIS IS YOUR BABY ON PAMPERS.

THIS IS YOUR BABY ON SPHAGNUM.

Photo by Doug Elliott

Questions?

Photo by Doug Elliott